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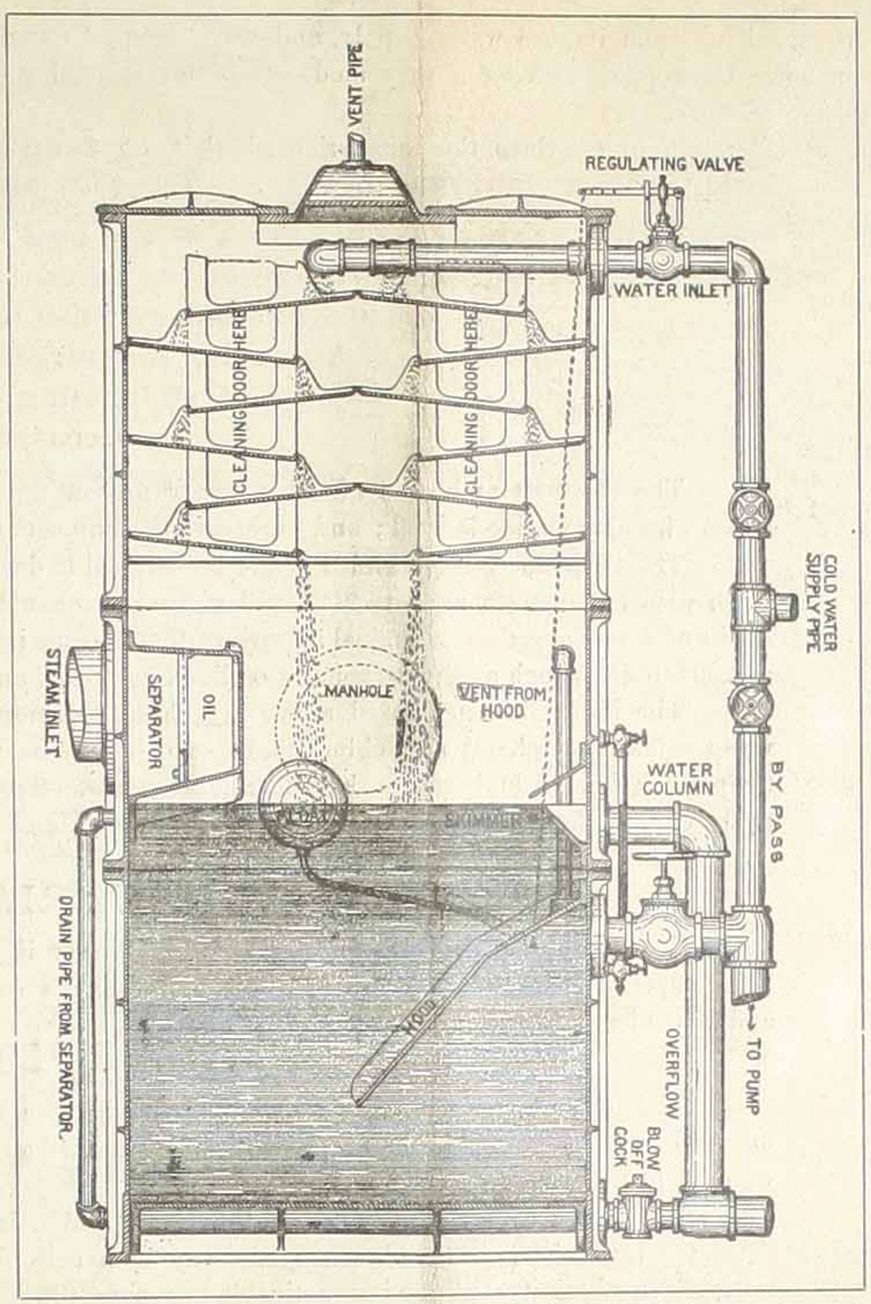
THE COCHRANE
FEED-WATER HEATER AND PURIFIER.

PATENTED
MAR. 3, 1885. FEB. 4, 1890.

Machinery, Tools AND Supplies.



Engines, Boilers AND Pumps.

MANUFACTURED BY

HARRISON SAFETY BOILER WORKS,

GERMANTOWN JUNCTION, PHILADELPHIA, PA.

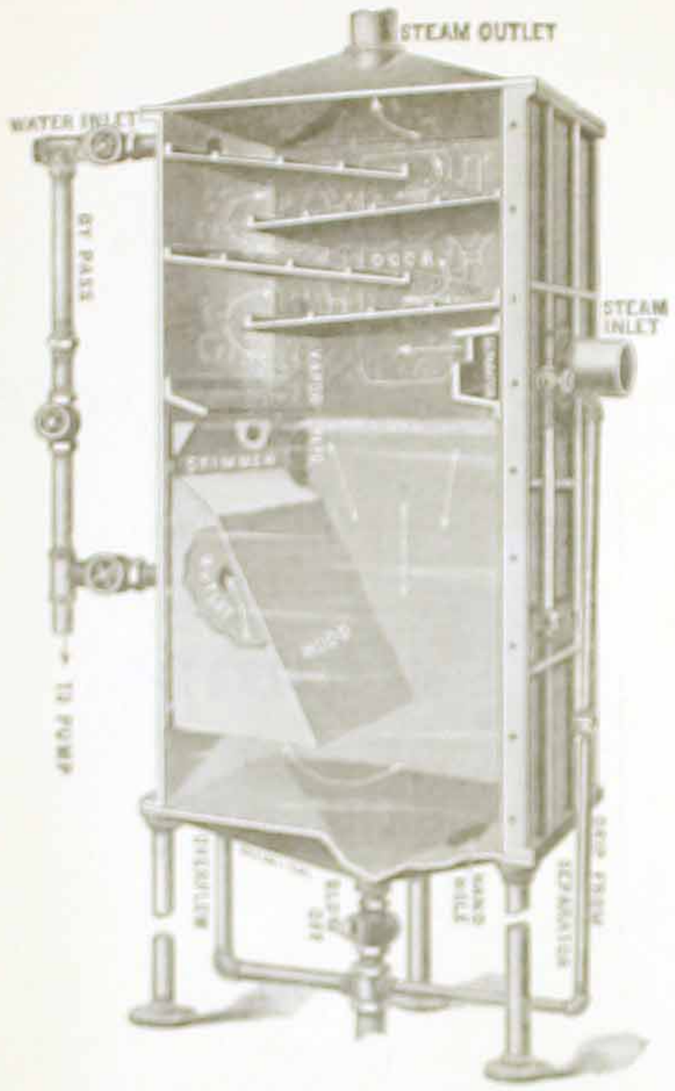
THOS. K. CAREY & BROS., Agents,
26 Light Street, BALTIMORE, MD.

PREFACE.

The loss and trouble suffered by steam users, arising from impure water supply, and from unequal expansion and contraction of the portions of boilers receiving cold feed-water, can in nearly every instance be stopped, and for a very moderate outlay, a trifling one as compared with the cost of wasted fuel, damaged boilers, repairs and cleaning, and stoppage of work.

Engineers agree, and it needs but little consideration to convince the inexperienced, that **to feed a boiler with cold or impure water results in a waste of money.** This waste commonly amounts to

12 per cent. to 20 per cent. of the coal bill;
A large percentage of the rated capacity of the boiler;
Loss of time and expense of repairs;
An outlay for purges, compounds, etc.;
A shortening of years in the life of the boiler;
Occasionally a destructive explosion.



SINGLE TRAY HEATER.

The cheapest and most effective way of preventing this waste, is to heat the feed-water by exhaust steam where an engine is used; and to remove the impurities before it enters the boiler.

The Cochrane Heater and Purifier is designed to do this, up to a certain point; that is, it will heat water with exhaust steam up to 212°, will remove mechanical impurities, such as grease, vegetable matter, mud and sand; also those chemical impurities that become insoluble in water in an open vessel at temperatures of 200° to 212°, such as the carbonates of lime, magnesia and iron.

The impurities mentioned above are those commonly met with. When, as is occasionally found, water contains sulphates and chlorides, these can only be removed by treatment in a special apparatus at temperatures much higher than that of exhaust steam. Such an apparatus or purifier is only supplementary to the exhaust heater and purifier; does not replace it; and cannot do its work.

MATERIAL.

The Cochrane Feed-Water Heater and Purifier is constructed entirely of cast-iron, this material being superior for the purpose to wrought-iron, as it is not so easily corroded by the acids in the feed-water and hence has a longer life.

CONSTRUCTION.

The form is square in horizontal section, with the top and bottom slightly dished. Each side is formed of one or more plates, strongly ribbed, which are bolted together at the flanges and made steam and water tight with rust joints.

Inside the heater, and covering the Steam Inlet, is attached a Separator, within which the oil is extracted from the steam and conveyed away by a drip pipe, so as to prevent it mingling with the feed-water, from which it would be impracticable to separate it.

The upper portion of the heater contains separate trays, varying in number and arrangement according to the size of the heater. These trays are slightly inclined, and have shallow ribs cast upon their upper faces, to distribute the water and retain solid substances.

The trays are interchangeable, each tier resting on the one below, except the bottom one, which rests on projections on the sides of the heater.

Hand holes and cleaning doors in the sides of the apparatus afford easy access to all its parts.

Opposite the separator, and a little below it, is a skimmer, or trough, extending the whole width of the heater. The overflow pipe from this skimmer, as well as the drip pipe coming from the separator, is coupled to the waste pipe below the heater.

Covering the outlet to the Pump, and extending well down towards the bottom, is a Hood, which is open at its under edge only. Connecting the apex of this Hood with the space above the water line is a Vapor Pipe, which serves to vent any gases liberated under the Hood and also prevents a vacuum being formed there, which might otherwise cause the surface of the water outside the Hood to be sucked down below its under edge and thus carry floating scum into the boiler.

The cold water inlet is provided with a By-pass to the pump, and with suitable valves. The Drip Pipe from the separator, the Overflow Pipe from the skimmer, and the Blow-off Pipe all join in a common Waste Pipe. The level of the surface of the water within the heater is shown externally by a gauge glass.

All the fittings shown in the illustrations accompany each heater, and are included in the price.

DIRECTIONS FOR CONNECTING.

Set the Heater in any convenient place; see that it stands *level both ways*, and that the outlet is at least two feet above the pump cylinder, so that the hot water will flow by gravity to the pump. Make Exhaust Steam and Vent Pipe connections in a general way, as shown by cut, the former of same size as steam opening into Heater, and as per list on page 7; lead a Vent Pipe from top of Heater back into Exhaust Pipe, extending $\frac{3}{4}''$ into the Exhaust Pipe—the size of this vent to be as per list on page 7. This latter pipe acts as a vent to pass away air and gas liberated from the water. If, however, it is intended to use part of the exhaust steam for other purposes, as for house heating, place a valve to regulate the supply of steam in the connection between the exhaust and the heater; in this case the Vent Pipe should enter the Exhaust Pipe beyond the Back Pressure Valve, where it has a free opening to the atmosphere.

Connect the cold water supply to the Inlet Pipe and the pump to the Outlet. Lead a pipe from the point marked on cut "Waste Pipe" to the sewer, or to any place where waste can flow without obstruction.

Where radiation is objectionable, as in basements and confined quarters, have the heater coated with magnesia, or other good non-conducting covering, except at the cleaning doors.

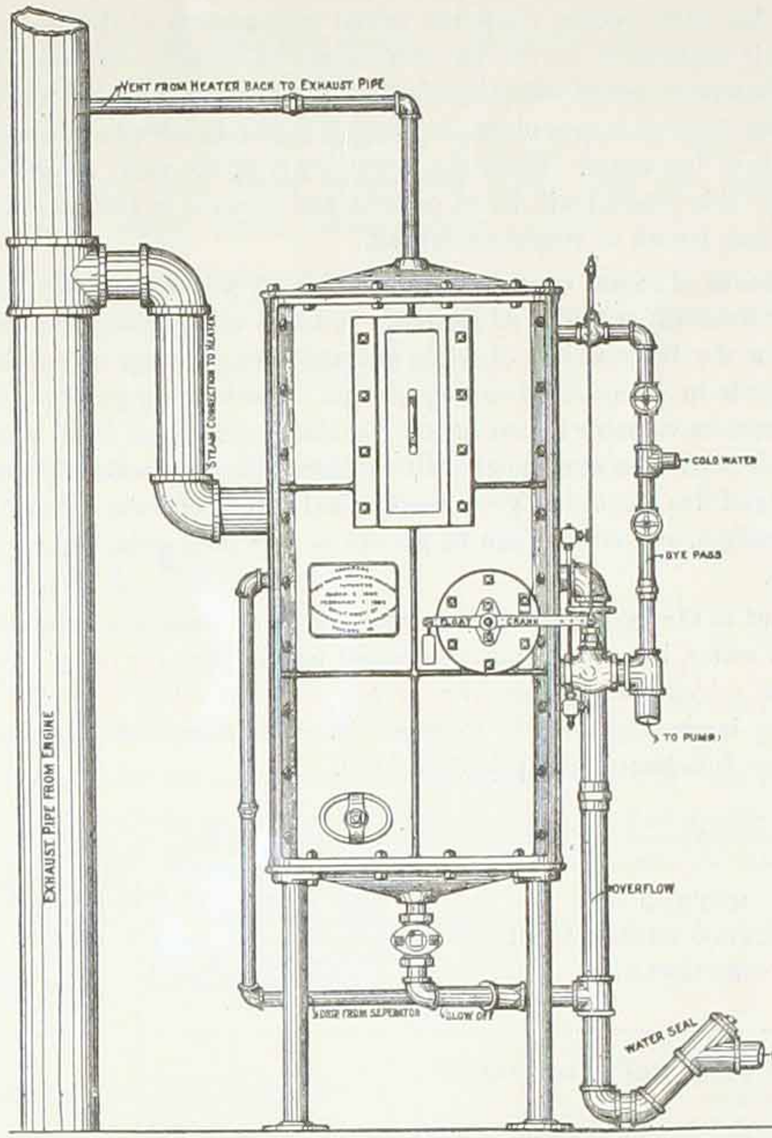
When the Heater is used in connection with the heating systems of buildings, special openings are provided for the return water, and an automatic valve and float are arranged to limit the supply of cold water to the quantity necessary to supplement the return water. The heater then takes the place of the drip tank otherwise necessary.

When part or all of the heated water is intended for dye-house, it can be accumulated in wooden tanks, and be drawn as required.

OPERATING THE HEATER.

Regulate the Water Inlet Valve and the Outlet Valve so that they will pass the supply wanted. Keep the pump running all the time, as a continuous feed gives a better chance for impurities to settle in the heater. Admit a surplus of water every two or three hours so as to flush the skimmer and run off any floating impurities.

Open the blow-off cock twice a day until the water level falls to the bottom



of the gauge-glass, unless experience has proved that less frequent attention secures equally good water.

The cleaning doors should be occasionally opened, and the trays should be cleaned whenever any quantity of deposit is found upon them. It is very important to see that the waste pipe is clear, and that the connections between the latter and the oil separator and the skimmer are kept open, as any obstruction in these pipes might cause the oil separator to become inoperative and the oil from the engine to flow back to the boiler.

GENERAL CONSIDERATIONS.

Water is heated in this apparatus by means of absorbing into itself (condensing) as much of the exhaust steam as will raise its temperature to about the boiling point. This process is practically instantaneous, and, instead of increasing the back pressure on the engine, tends to diminish it. Brought into direct contact with the water, and in largely excessive volume, the steam raises the former to its own temperature, and the temperature in the tank is between 208° and 212°. And this process, when the initial temperature of the feed water is 50° Fah., only requires ⅛ part of its own weight in exhaust steam. In other words, one pound of steam will raise six pounds of water from 50° Fah. to the boiling point, and as a pound of condensed steam is added, the product is seven pounds of hot water. When the temperature of the water supplied to the heater is 100° this product will be 9½ pounds, and when it is 150° it will be 16½ pounds for each pound of steam condensed.

The amount of steam which an average engine will deliver per indicated horse-power is usually taken at 30 pounds. It varies widely however from about 13 pounds in the largest class of triple expansion engines up to considerably over 60 pounds in many direct acting pumps. For heating purposes exhaust steam is almost as valuable as live steam, for steam condensed from a pressure of 100 pounds above the atmosphere will only heat 4% more water than exhaust steam will; and live steam has great mechanical value, whereas exhaust steam is a waste product, and all that can be got out of it is pure *gain*, being obtained without cost.

In regard to the saving which may be effected by using the exhaust steam to heat feed water, it may be stated in round figures that *for every 10 degrees which is thus added to the temperature of the feed water 1% of fuel is saved.* The following interesting table by Professor D. S. Jacobus, M. E., is taken from the "Stephens Indicator" of April 15th, 1888.

METHOD OF SUPPLYING FEED-WATER TO BOILER.	Relative amount of coal required per unit of time, the amount for a direct acting pump feeding water at 60°, without a heater, being taken as unity.	Saving of fuel over the amount required when boiler is fed by direct acting pump, without a heater.
Direct acting pump, feeding water at 60° without a heater	1.000	.0
Injector feeding water at 150°, without a heater	.985	1.5
Injector feeding water through a heater in which it is heated from 150° to 200°	.938	6.2
Direct acting pump feeding water through a heater in which it is heated from 60° to 200°	.879	12.1
Geared pump, run from the engine, feeding water through a heater in which it is heated from 60° to 200°	.869	13.2

These results do not take any account of the purifying action on the feed-water, the improved condition of which by diminishing the average deposit within the boiler materially increases both its capacity and its economy; while the more uniform temperature accompanying the use of a hot feed reduces the repairs and lengthens its life. The tabulated savings should also be increased for temperature, as the water in the Cochrane Heater is raised nearer to 212° than to 200°.

If the quantity of water passing through the heater is only what is required to furnish steam for the engine from which the exhaust comes, more than four-fifths of this steam will remain uncondensed, and will thus become available for other purposes, such as heating buildings. Water from the hot-well of a condensing engine may be advantageously passed through the heater, provided there is exhaust steam remaining to supply it. Live steam can only be used economically in a heater when exhaust steam is not available, but it is equally effective in both purifying and heating the water.

There are three means by which the water is purified in the Cochrane Heater: (*a*) by mixing with it a considerable amount of pure condensed water; (*b*) by floatation and the removal of the light impurities which congregate on the surface by means of the skimmer; and (*c*) by settlement and the removal of the heavy impurities through the blow-off cock.

Both mechanical and chemical methods have been used for the removal of those impurities from the water which would cause hard scale, or soft sedimentary deposits in the boiler. As a rule the mechanical are preferred, as being both the least costly and the least dangerous. Such a method is that employed in the Cochrane Heater. The carbonic acid gas is first driven off by the heat, and the carbonates of lime which previously existed in a state of solution in the water are largely precipitated, and these, together with the impurities held in mechanical suspension, are carried off through the blow-off cock and the skimmer as described. If sulphates of lime or magnesia are present, however, a higher temperature than 212° will be required for their precipitation, and the water should afterwards be passed through a properly designed *live* steam purifier. The carbonates of lime and magnesia form the bulk of the scale in boilers, and are thus responsible for a great waste of fuel, frequent cleanings, troublesome repairs and the early deterioration of the boilers.

Attention may be called to the very effective arrangement recently patented and now supplied with each heater, for the removal of the oil or fatty matter from the exhaust steam. Fatty matter and heavy mineral oils accumulating in a boiler will keep the water away from the hot surfaces, thus diminishing the evaporative efficiency of the boiler, and permitting the metal to be burned, distorted and ruptured. Any oily matter floating on the surface will induce foaming. Such matters, which are too frequently allowed to pass into a boiler in large quantities even when so-called separators are used, are so thoroughly removed by the Cochrane apparatus that no perceptible trace of oil can be found in the water which has passed into the tank, nor has any been found in the boilers supplied by the Heaters even after long continued use.

Why we Advocate Open Exhaust Heaters.

We have selected an *open exhaust steam heater* (that is, one in which the exhaust steam comes into direct contact with the water) to put upon the market solely because, in the majority of cases, it appears to be the best of all the systems before the public.

As compared with closed (or pipe) heaters,

***A*—It is less expensive in first cost.**

***B*—It is more easily cleaned and more durable.**

***C*—By direct contact the steam raises the water to a higher temperature than when it has to do so through the walls of metal pipes.**

***D*—It utilizes the pure water of condensation, and thus saves a large proportion of its heat.**

***E*—As the water in the tank is in contact with the steam on the top of the water only, no circulation takes place in it, as it does in all pipe heaters, and thus precipitation of sediment is not impeded by the currents.**

The purifier fed with live steam at boiler pressure is of all others the best, so far as the prevention of hard scale is concerned, but where sulphates are not present the exhaust steam heater is equally effective for purification, and, while much less costly, has the advantage of utilizing heat which would otherwise be wasted. Indeed, even when the presence of sulphates renders the live steam purifier necessary, it should be only supplementary to the exhaust steam heater, which is both best and most economical as a primary link in the chain.

TESTIMONIALS.

Cheney Brothers, Silk Manufacturers.

South Manchester, Conn., *April* 1, 1891.

HARRISON SAFETY BOILER WORKS,
Philadelphia.

Dear Sirs:—Your letter of March 17th, inquiring about the Cochrane Feed-Water Heater and Purifier, has been received.

We have three of these heaters in use, two for heating water for our dye-house, and one for heating and purifying feed-water for one of our boiler plants. We find this heater specially well adapted to dye-house work, owing to its large heating capacity, low cost and simplicity. The boiler feed-water heater and purifier we have furnishes feed-water for a boiler plant of about 1500 H. P., and does its work to our entire satisfaction. When we have sufficient exhaust steam, the water is heated to a temperature of 208 degrees, and we have no trouble whatever from the grease contained in the exhaust steam.

Yours truly,

CHENEY BROTHERS,
By FRANK CHENEY, Jr.

Purcell, I. T., *March* 23, 1891.

HARRISON SAFETY BOILER WORKS.

Gentlemen:—Would say in reply to your favor of the 17th instant, as regards the heater, we are perfectly satisfied with its workings. We find it to be a great saving in fuel, and as for the grease passing through the exhaust into the boiler we have no trouble whatever.

Very respectfully yours,

WILLIAMS BROS.

Dallas, Texas, *February* 3, 1891.

HARRISON SAFETY BOILER WORKS,
Germantown Junction, Philadelphia, Pa.

Gentlemen:—Replying to your communication of the 31st ult., we will say that we have had one of the "Cochrane Patent Feed-Water Heater and Purifiers" in use for about one year and a half, and it has done its work very satisfactorily. Our engineer says that he prefers it to any that he has had experience with.

Very respectfully,

SANGER BROS.

Whittenton Manufacturing Co.

Taunton, Mass., *May* 2, 1889.

HARRISON SAFETY BOILER WORKS,
Germantown Junction, Philadelphia, Pa.

Dear Sirs: Yours of the 13th ult. is received. I am very glad to be able to say that your Cochrane Feed-Water Heater, which we have had in use for the past two years, or nearly two years, gives entire satisfaction. We have not been troubled with Cylinder Oil. We can heartily recommend it to any one in need of a heater.

Yours truly,

CHAS. L. LOVERING, *Treasurer.*

The Ammonia Co. of Philadelphia.

THE HARRISON SAFETY BOILER WORKS.

Gentlemen: In answer to your inquiry touching the Cochrane Feed-Water Heater, I beg leave to say, we purchased one from you about one year ago.

It has given satisfaction, and fulfills the representations made by you in regard to it.

No trouble has been caused by oil in our boilers, and we consider the apparatus both simple and reliable.

Very truly yours,

HENRY BOWER.

Philadelphia, *April*, 24, 1889.

HARRISON SAFETY BOILER WORKS,
Germantown Junction, Philadelphia.

Gentlemen: Your Cochrane Heater and Purifier, sold us in 1885, and since then in almost daily use heating the feed-water for our Harrison boiler, has given us entire satisfaction.

We use the Schuylkill water, and the heater takes the exhaust direct from the engine. We have had our boilers cleaned out but once—two years ago—and then found a mere film of scale and but little sediment. There was no evidence of oil in the boiler.

Your representations regarding the heater having been fully borne out by our experience, you are at liberty to use these statements.

Yours truly,

DANDO PRINT. & PUB. CO.,

THOS. S. DANDO, *President.*

Jackson Woolen Manufacturing Co.

Jackson, Tenn., *April* 17, 1889.

MESSRS. HARRISON SAFETY BOILER WORKS,
Germantown Junction, Philadelphia.

Gentlemen: The Cochrane Feed-Water Heater bought of you in January, 1888, has given entire satisfaction. We have accomplished more work in 1888 than we did in 1887, and our fuel bill is $492.00 less.

We attribute the result to the Feed-Water we are using—*mainly.* Figures won't lie, "they say," anyway, the above was eminently gratifying to us.

Yours truly,

ROBERT A. ALLISON,
Secretary.

Brooklyn, *April* 16, 1889.

HARRISON SAFETY BOILER WORKS.

Gentlemen: We have been using your Cochrane Feed-Water Heater since November, 1883.

It has given entire satisfaction, and would recommend it to any one in need or a heater.

Yours truly,

S. M. McCLURE,
Agent for Estate of Jos. M. McClure.

Terre Haute, Ind., *April* 16, 1889.

HARRISON SAFETY BOILER WORKS,
Germantown Junction, Philadelphia.

Dear Sirs: We have your letter of the 13th, and in reply to your inquiry concerning the working of the Cochrane Feed-Water Heater, would say that we have had one in use for nearly two years and find it very beneficial. We appreciate it very much, bought another one for our Mt. Vernon Mill last September, and can recommend it to those contemplating buying.

Yours truly,

HUDNUT MILLING CO.,
Per B. G. HUDNUT, *Secretary.*

Mechanicsburg, Pa., *April* 15, 1889.

Gentlemen: We take pleasure in stating that the "Cochrane Feed-Water Heater," purchased of you, gives very satisfactory results. Our boiler is remarkably free from scales or deposits of any kind, while we believe a very considerable economy is effected by the use of feed-water as hot as is the case when using this heater.

We cheerfully recommend the device, and shall be glad to learn of your continued success in this line of business.

Yours very truly,

HAUCK & COMSTOCK.

COCHRANE FEED-WATER HEATERS AND PURIFIERS,

Adapted for both Purifying and Heating.

RATING.			DIMENSIONS.					
			INSIDE OF HEATER.					
No.	HP.	PRICE.	Inches Square.	Feet High.	Diameter of Steam Inlet.	Size of Vent Pipe.	Diameter of Water Inlet.	Diameter of Water Outlet.
1	15	$ 90	20	3	1½″	¾″	¾″	1″
2	30	125	20	4	2″	¾″	¾″	1¼″
3	45	160	24	3½	2½″	¾″	¾″	1¼″
4	60	190	24	4½	3″	1″	1″	1½″
5	80	230	28	4	3″	1″	1″	1½″
6	100	260	28	5	3½″	1″	1″	1½″
7	130	300	32	5	4″	1″	1¼″	2″
8	160	340	32	6	4″	1″	1¼″	2″
9	200	380	36	6	4½″	1″	1¼″	2″
10	250	410	36	7	5″	1¼″	1½″	2½″
11	325	450	42	7	5½″	1¼″	1½″	2½″
12	400	550	42	8	6″	1½″	1½″	3″
13	500	700	48	8	7″	2″	2″	3″
14	750	950	42 x 74	8	8″	2″	2½″	3½″
15	1000	1150	48 x 96	8	10″	2½″	2½″	4″

PRICES, WHEN HEATING ONLY IS CONSIDERED.

Where *heating* the water alone is desired (the quality of the water being already suitable for boiler purposes), and there is sufficient steam, these heaters can be worked to 2½ times the capacities at which they are rated in the above table, but larger pipes and valves will then be required which we will supply at an additional cost of 5%. Thus No. 6, which is rated for purifying at 100 HP., and costs $260.00, would for *heating* only, rate at 250 HP., and cost $273.00.

Prices include Gauge-glass, Blow-off Cock and Water Connections complete, as shown in circular.

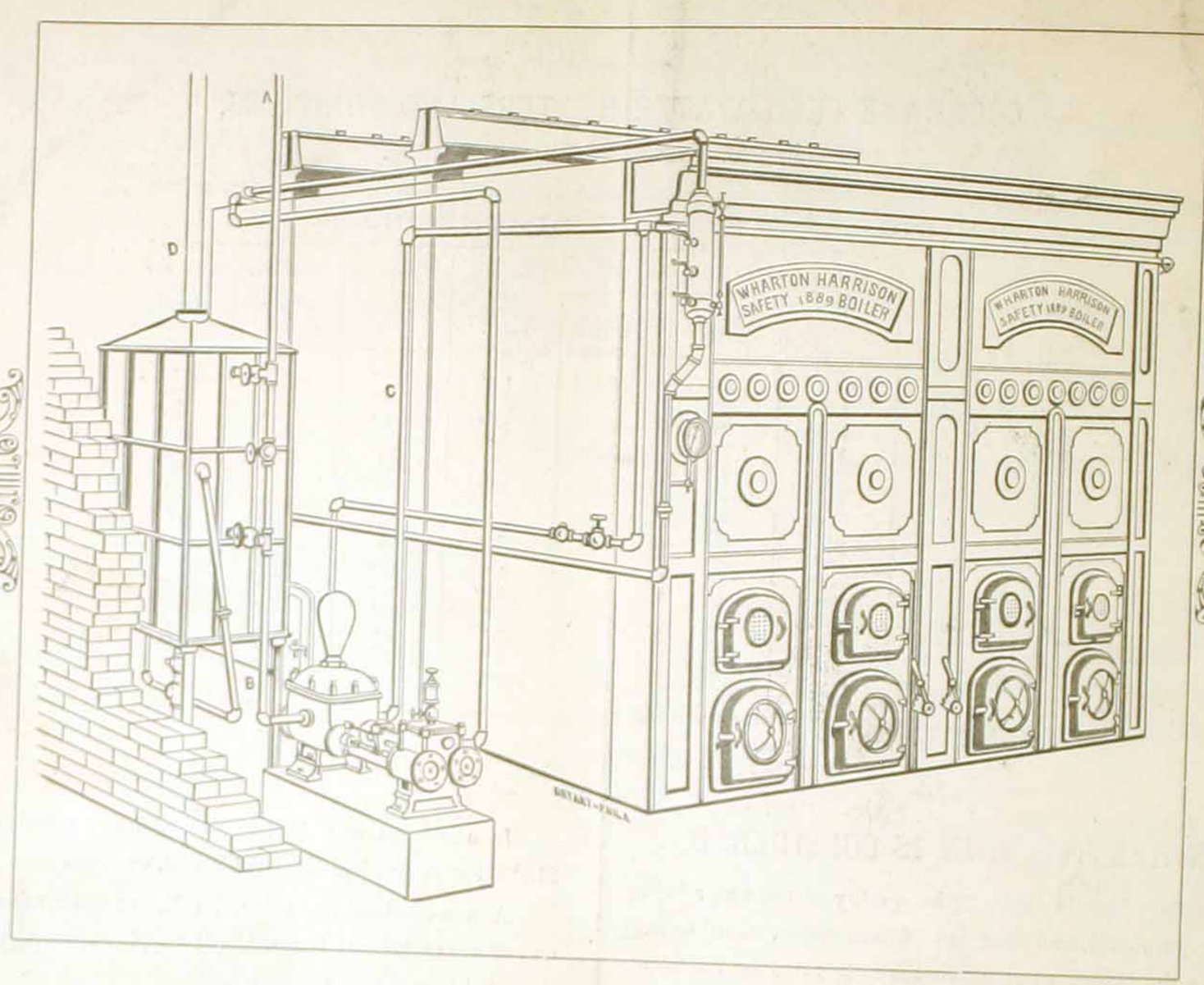
In above rating a HP. is reckoned as equivalent to 30 lbs. of water at 212° F., or approximately ½ cubic foot, or 3¾ gallons.

A non-condensing engine, developing one-sixth of the HP. at which any one of above heaters is rated, will supply sufficient exhaust steam, to develop the rated capacity of the heater.

If openings of different sizes from those specified above are required, special mention should be made with order.

When ordering, state Diameter of Cylinder, Stroke of Engine and number of Revolutions; also the Boiler Pressure.

The Cochrane Feed-Water Heater and Purifier.



TO STEAM USERS:

Examine details of Heaters and Purifiers in the price list, if troubled with bad water. They combine excellence with low cost, and their intrinsic merits will warrant your investigation.

Read description of our Heaters and Purifiers, and our claims for them.

Write to us for our guarantee, and any further information desired.

We design and contract for steam plants complete, and invite application for plans and estimates.

HARRISON SAFETY BOILER WORKS.

Thos. K. Carey & Bros.,

AGENTS,

26 Light St., BALTIMORE, MD.